GMOs- What are They and What do They Mean for Producers and Lenders?

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Biotechnology, the science of altering nature; it holds the promise of opportunities in food security, productivity and pharmacology limited only by imagination. For many individuals and consumers, however, it represents a Pandora's Box that we open at our own risk. To a certain extent, both sides are right. Biotechnology offers new opportunities to improve agricultural output, reduce the environmental impact of agricultural practices and to develop new products with unique capabilities and features. However, the potential benefits come with many risks, both real and perceived. Some are related to the science of biotechnology, some to consumer reaction to genetically modified organisms (GMOs), while others are related to the business of capturing the value associated with biotechnology. Regardless of individual reactions to biotechnology, few doubt that it will change agriculture. Understanding the nature of the opportunities and risks associated with biotechnology is essential both for producers and for the organizations financing their crops and their farms. In this paper we examine the current status of GMO's in the agrifood sector. We begin with a brief introduction to biotechnology and its role in the business of producing and processing food. We examine the reaction to biotechnology by both producers and consumers and the impact of their different reactions on the food processing and distribution organizations between them. Finally, we consider the impact of GMO production on the lender-borrower relationship and provide a list of questions that lenders should ask their customers to assess and mitigate GMO related producer and lender risks.

BIOTECHNOLOGY AND THE AGRIFOOD SECTOR

Biotechnology is the term commonly used to describe the process of manipulating and combining genetic material, frequently from different organisms. To provide bacteria, plants, or animals with special characteristics that are not usually found naturally, genetic engineers insert genes from other organisms that exhibit the characteristic, thereby imparting new qualities to the receiving organism. Such *recombinant DNA* procedures have been available for many years in the pharmaceutical industry but they have only recently become widely used in agriculture.

Genetic engineering in agriculture tends to fall into two broad categories, the development of traits related to production, *Input Traits*, and the development of traits related to final product characteristics, *Output or Quality Traits*. Most agricultural biotechnology products available today fall into the first category. Examples include plants with herbicide-resistant properties like Monsanto's Round-up Ready soybeans or corn or AgrEvo's Liberty Link soybeans. These plants allow crops to be sprayed with highly effective herbicides, minimizing both the costs and environmental impacts of weed control. Another popular category of genetic modifications imparts insecticidal properties to plants through insertion of Bt genes from bacteria.

According to the science-based view of biotechnology products, the resulting crop is *substantially equivalent* to non genetically modified crops. In other words, the GMO crops are essentially the same as their non-GMO counterparts and GMO and non-GMO crops may be used interchangeably. These input trait crops provide benefits to the producers using them through lower production costs, reduced labour, increased yields and quality or reduced environmental impact. Currently the benefits are shared between the supplier of the seed and the producer. The seed supplier captures their value through higher seed prices or through a Technical User's Agreement (TUA). These agreements include a charge/acre for using the modified seed and may impose conditions and restrictions on seed use.

Unlike those with input-traits, crops with *Output Traits* are engineered to produce specific products or characteristics. In many crops, like high-oil corn and soybeans, high value characteristics have been enhanced through traditional breeding programs. The advent of recombinant DNA methods has increased the speed and range of output trait enhancements, allowing the development of totally new and much more valuable characteristics. For example, a human gene inserted into a variety of tobacco causes the production of Interlukin, with applications for the treatment of Crohn's disease. Output traits are only beginning to become commercialized. By far the most controversial genetic modification at the producer level is the introduction of terminator genes, genes that will allow only a single generation of production from a crop.

Producer Reaction to GMOs

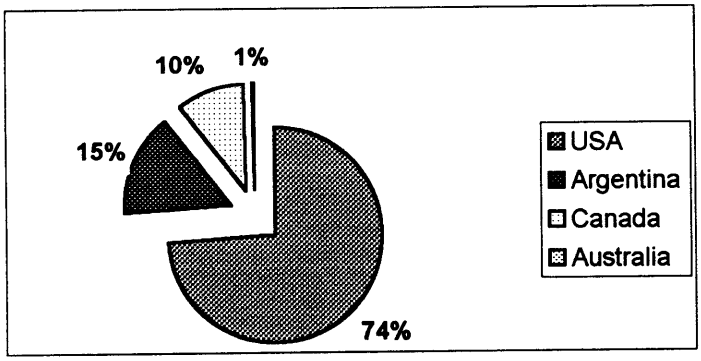
Producers have been quick to recognize the advantages of GMO crops and adoption has been increasing rapidly (Table 1). Plantings of GMOs in cotton, corn, soybeans and canola are projected to be 50% of total 1999 global plantings. Adoption to date has been primarily Roundup Ready and Bt crops. Global GMO production is concentrated in North America and Argentina as illustrated in Figure 1.

Table 1. Global Area Of Transgenic Crops

Crop	1997 (millions of	1998 hectares)	% Increase	% of Total Crop
Soybean	5.1	14.5	184%	60%
Corn	3.2	8.3	159%	32%
Cotton	1.4	2.5	79%	14-18%
Canola	1.2	2.4	100%	60%

Source: William Lesser, Transitions in Agbiotech: Economics of Strategy and Policy, NE165 Conference, Washington, June, 1999.

Figure 1. Global Distribution of Transgenic Crops (1998)



Source: World Watch "The Emperor's New Crops" July/August 1999, pg. 23.

The economic benefits of these input trait crops have accrued principally to seed companies and producers. Consumers have tangentially benefited from sustained low prices due to increased supply and quality, as well as intangible benefits such as lower use of herbicides and pesticides. Unfortunately, these benefits are not readily apparent to many consumers, who perceive GMOs as having no benefits and unknown or undisclosed risks.

Regulation of GMOs

Genetically modified crops are tested in controlled release programs overseen by government agencies like the USFDA and the Canadian Food Inspection Agency. Test plots are authorized by these agencies but controlled by the individual seed companies who report to the regulatory agencies. Although many varieties are approved for use in North America, other markets have been more reticent in their acceptance of GMOs. For example, the European Union has approved several, but not all GMOs used in North America. EU approval was for importation only and not for production.

Consumer Reaction to GMOs

Consumer reaction to GMOs has been considerably less favorable. In the United Kingdom, the experience with BSE (mad cow disease), and more recently the dioxin problem in Belgium have reduced the level of trust in the food system in general and have damaged government and industry credibility concerning assurances of food safety. This suspicion has carried into the area of GMO crops. To suspicious UK consumers the term *"substantially equivalent"* really meant *"somewhat different"*. One of the problems with input trait crops is that the benefits are received primarily at the input and production level and not at the consumer level. With no perceived benefits and a multitude of perceived risks and uncertainties consumers have been saying no to GMO's.

The debate over GMOs has spread rapidly and loudly across the EU to Japan, Australia and New Zealand. On one side, consumer and environmental groups like the Council of Canadians and Greenpeace clamor for protection from the unknown risks of biotechnology. Farm groups and large biotechnology firms like Monsanto and Novartis watch as one by one markets close to GMO crops. Although they continue to promote GMO crops as safe and good for both consumers and the environment, the assurances appear to have fallen on deaf ears. They are left with the questions "Why?" and "What they should do next?"

The first truth that observers should recognize is that the debate over GMO's is really a bilingual one; two very different languages are being spoken. While the production and biotechnology

side speaks calmly and logically, relying on science and reason, those opposed to GMOs, protest and destroy fields of GMOs, all the while shouting about morals, ethics and risk. The spread of resistance to GMOs shows that the latter language is the one people understand and respond to. Answering the question "why are consumers reacting this way" is somewhat easier than answering question "what should producers and biotechnology companies do next".

To gain some understanding of consumer reaction, consider the most basic definition of food – "That which is eaten, drunk or absorbed by an organism for the maintenance of life and the growth and repair of tissues"[1]. The definition is technical and scientific, but is that how consumers truly view food? When asked to draw pictures of what food represents to them the most frequent image drawn by focus group participants was of a family sitting around a table[2]. Advertisers and marketers rarely attempt to convey images of sustenance when trying to reach consumers. Instead they attempt to draw on the qualitative attributes that food represents. To advertisers and consumers, food represents healthy family, togetherness, love, culture and passion. Sustenance and science only matter when food is in short supply. Food is emotional and emotion is the language of GMO opponents who portray GMO foods as a threat to all the good things that food represents. In contrast, arguments phrased in the language of science and technology simply aren't reaching consumers.

In the E.U., retail chains have been placed in a difficult position. Government regulations distinguish between approved and non-approved varieties of crops. Customers do not make such fine distinctions: To them products either contain GMOs or they do not. They insist to their retailers that GMOs be either removed from products or be labeled as containing GMOs thus providing them with the option of avoiding them. Faced with a choice of obeying regulations or meeting customer wishes, retail chains have made the only decision they could - they did what their customers wanted. The first to commit to GMO free private label products was Iceland, a major U.K. food retail chain. The others followed shortly afterward. Recently Sainsbury's, another U.K. food retailer announced that it had successfully removed GMOs from all of its

[1] Funk and Wagnalls Standard Desk Dictionary, 1984, p. 248
[2] A report of Findings from the Qualitative Communications Strategy Development Research, prepared for Foodland Ontario by Decima Research, 1997

private label products in its 415 store chain[3]. Sainsbury's website contained a statement that it would draft policies to remove GMOs fed to animals used to supply meat to its stores. To avoid the possible contamination of GMOs in private label products, many food-processing organizations are reformulating their recipes, replacing ingredients that could contain GMOs with ingredients for which there are no GMO varieties. For example, on September 13th, 1999 Marks and Spencers announced that they would start removing GMO soya and maize ingredients from animal feed. The initial intent was to remove GM feeds from free range chicken, eggs and pork, products that were more available in selected stores in October. This move by Marks and Spencers followed a commitment made in early 1999 to remove all GM foods produced with soya, maize or derivatives from the grocery and confectionery shelves. This was done by September of 1999 and the fact that Marks and Spencers was GMO free was used as a tool of retail marketing[4].

As the controversy rose through the summer of 1999, pressure on governments to take a stand on GMO's intensified. While government and industry representatives in North America attempted to counteract negative press, the outcry against GMOs spread around the world. The furor progressed and spread to the point where Japan, New Zealand and Australia have all committed to drafting legislation concerning the labeling of genetically modified foods. In Japan, mandatory labeling is set for April 2000 with a one year adjustment period. Labeled items include those whose DNA could be identified but excludes items where the DNA is processed to the point where identification is impossible. Although exact levels have not been specified, the trend appears to move to a 1% threshold as adopted by Switzerland and the E.U.

The controversy is no longer confined to markets outside North America. In July 1999, baby food manufacturers Gerber and Heinz announced that they would remove all GMOs from their line of baby foods. For biotechnology giant Novartis, the owner of Gerber, this was not a step to be taken lightly. However, companies ignore consumer concerns and requirements at their peril. The trend toward labeling is almost certainly to increase. The true measure of consumer concern

[3] "Fear is growing; England is the epicenter", St Louis Post Dispatch, July 25,1999, pg. A11.
[4] www.marksandspencer.co.uk/corporate/press-releases/19990913.001.html

over GMOs will not come until they have to choose between clearly labeled non-GMO products and less expensive GMO products.

Some of the lessons learned in watching events unfold are that if one retailer becomes GMO free, the rest will follow. The first retail chain will move when it perceives a market advantage/necessity to provide GMO free products. Retailers are demanding certification and documentation of GMO free status and many have gone well beyond regulatory requirements in response to consumer demand.

OPPORTUNITIES AND RISKS ASSOCIATED WITH GMOs

Biotechnology will change the nature of agricultural production and as production changes the systems supporting it will have to change as well. Through genetic engineering, scientists can literally reshape life. Production characteristics and limitations will no longer apply as new organisms are designed to meet specific market requirements and production conditions. Opportunities and risks associated with GMO's arise from both the science of biotechnology and the consumer reaction to the moral and ethical issues around biotechnology. In other words, producers may be able to capture value regardless of which language they speak. They also face risks no matter which side of the debate they are on. In the following sections we consider both the opportunities and risks for producers and the impact that these may have on agricultural lenders.

GMO Opportunities For Producers

Opportunities for producers adopting GMOs result from either improved production results or new market opportunities.

Production Benefits

Higher yields and quality, savings in spraying costs, reduced labor, simpler spraying regimes and reduced environmental impact all contribute to the appeal of input trait GMOs for producers. While benefits and impact on profitability vary with regional characteristics and challenges, the positive impacts of GMOs on producer profitability are apparent (Lipton, 1999). These benefits

are limited primarily to the seed company and producer levels. The insecticidal properties of some genetically modified crops can greatly reduce producer risks of losses associated with pest infestations. The economic benefits are only just beginning to be analyzed but are

Some biotechnology products may help producers avoid lawsuits and regulatory implications in the future. For example, the recent development of a low phosphate pig could reduce the negative environmental impacts of large hog farms.

Market Opportunities

The second wave of GMO crops, those with output traits, will include high value recombinant varieties whose special characteristics will command premiums. It is in these crops that the opportunities for capturing significant benefit lies. Many will be small volume/high value crops grown under strict production protocols. For high value, output products that are smaller and identifiable may become more important than large and efficient. There will be new opportunities for organizations with the infrastructure to support identity preserved production. Producers demonstrating appropriate capabilities may participate in these high value production chains. In some cases exploiting these opportunities may require the establishment of a co-operative to tightly control the production environment in a restricted geographic area. For lenders the challenge may be in placing a value on new crop opportunities.

Non-GMO Market Access

On the other side of the equation, lie opportunities for producers who produce non-GMO varieties. With markets either rejecting GMOs or demanding that they be labeled, demand for non-GMO varieties is increasing. For some organizations, maintenance of a non-GMO supply chain was a strategic choice, for others lagging behind industry innovators may turn out to be a competitive advantage. For example, while there are GMO varieties of food grade soybeans approved for production in the US, no GMO varieties have been approved and planted in Canada. This has made Canada an attractive source for non-GMO soybeans for Japanese and EU firms and Canadian grain companies are experiencing an increase in demand as a result.

Capturing The Value

The value associated with input traits will be captured at the farm and input supply levels. To use these products producers may have to follow altered production practices, set out by the seed suppliers. Monsanto's Technical User Agreements (TUA) specify the conditions under which the crops may be produced. For Bt crops, these TUA's are designed to reduce the possibility of the development of resistance to the insecticide in targeted pests. The TUA includes conditions for setbacks, buffer strips and non-GMO refuge areas for non-resistant pest protection.

Regardless of whether the ultimate market is GMO or non-GMO there will be requirements and advantages for producers and other members of the supply chain who can preserve the identity of the crop from seed to consumer. Identity preserved production (IPP) requires different production, transportation, storage and tracking procedures. Crops must be segregated through the supply chain by variety, non-GMO/GMO or by output trait. IPP systems are not new and have been used in plant breeding programs for years. Recently, IPP has slowly spread into more mainstream production in response to food safety concerns. The controversy over GMOs is now forcing adoption of IPP methods at an unprecedented rate. Unfortunately IPP capabilities lag behind demand for IPP; customers are insisting on a process of identity preservation that the industry is generally unprepared to deliver.

Identity preserved production requires three key components.

1. ***Procedures and Protocols***

   The first requirement includes procedures and protocols for maintaining product identity. These are clearly specified in contracts and agreements between input suppliers and producers.

2. ***Product identity verification***

   The second involves proving that the product delivered is exactly as specified. For many products, the physical appearance of GMO and non-GMO products is identical. Proving identity is currently accomplished in one of two ways

   - Genetic identity testing – specific gene sequences are used to determine genetic identity, most commonly through a procedure known as Polymerase Chain Reaction, PCR, or a faster, more accurate variation, Real Time PCR. These

processes are long, complicated and expensive and must be done by skilled technicians.

- Protein testing – there are tests available on the market which test for target protein levels in crops to determine whether there are GMOs in the crop. These are not as accurate as genetic identification methods but provided a quick, easy to use screen test.

As limits for GMO labelling are established worldwide this testing will include the additional requirement of quantifying the GMO content of crops destined for non-GMO markets.

3. ***Certification***

The final need is for certification of the IPP processes and tests used. Certification and audits by third party agencies are needed to assure customers that protocols are being followed. This may be incorporated into quality management systems like ISO 9000 or HACCP but current efforts appear to be moving toward separate GMO certification systems. These may ultimately be merged into a single food certification system encompassing all aspect of GMO, food safety and quality under one umbrella.

One aspect of identity preservation is obvious, smaller identifiable production and storage units will provide a competitive advantage in selected markets. Producers with on farm storage and dedicated equipment will have more opportunities to participate in higher value markets. For some higher-volume niche markets, producers may form co-operative groups, dedicating production in specific regions to niche markets. In this way, co-operatives can supply larger markets with reduced possibilities of contamination or lost identity. These co-operatives may also provide the scale needed to justify investment in dedicated equipment and storage as well as in new production tracking systems.

GMO Risks For Producers

In some cases the science of biotechnology will reduce producer risk, in others it will increase it. Producer risk exists across several dimensions some related to production, some related to GMO characteristics and others related to consumer reaction to GMOs and the risks associated with them

Production Risks

At the industry level, the possibility that natural competitors or pests may adapt to the genetic modifications poses a threat to entire industries. While it is likely that such changes will occur gradually, there may still be significant impacts in localized regions.

Another industry level is the impact of biotechnology on production in previously inhospitable environments. For example, production of more cold resistant strains of grapes will increase wine production capabilities in new regions. For producers in these new growing areas this represents an opportunity. For producers in established production regions, such introductions will facilitate new entrants, intensifying competition.

One particular difficulty for the agricultural sector is the time needed to respond to unanticipated market shifts. Development of new seed varieties through conventional breeding typically takes about seven years. Although biotechnology speeds the process significantly, there is still a lag between seed production, field production and consumption due to the realities of crop production. This lag adds temporal risk to GMO risks at the producer level. For example, in Canada approximately 35% of the 1999 soybeans planted were Round-up Ready. Forecasts for 2000 were that approximately 60% of the crop would be Round-up Ready. Since the seeds to be planted in 2000 had to grown in 1999, Round-up Ready seed crops were planted based on original projections. The controversy over GMOs has many producers rethinking their crop selection and the GMO/non-GMO seed mix may be significantly out of balance for the next growing season. This was highlighted in a speech by the President of the Canadian Wheat Board on October 19, 1999 recommending that no transgenic varieties should be registered for commercial production in Canada until they achieved full acceptance in all of their potential markets or could be segregated in a cost effective manner throughout the system.

Several producer level risks are associated with the production of GMO crops. The most significant relates to cross-pollination and the risk of contamination of non-GMO crops or different GMO crops. Producers whose crops contaminate neighboring fields may be sued if that contamination results in significant loss of crop value. This risk is particularly high in corn

production where cross-pollination is a common and well-documented occurrence. At this time studies are underway to determine the level of risk and optimal strategies for reducing that risk. Contaminating the crops in an elevator or ship either accidentally or intentionally to capture higher value may result in lawsuits against producers. Testing and certification will reduce the risk of production error or moral hazard on the part of producers.

Some risks are relatively easily avoided if producers use care. These include errors like planting or spraying the wrong field. With round-up ready crops everywhere, spraying with Roundup on healthy crops is a foreseeable error with disastrous results. Worse is planting the wrong seed in a field since that may result in contamination of larger volumes of product as crops are harvested and stored with other harvests. On farm storage reduces this risk significantly since crops may be tested before they are accumulated and shipped to processors or consumers.

Environmental contamination through transfer of characteristics or development of pest resistance represents a sector wide risk. Individual producers may face liability if it is proven that they did not follow recommended procedures. Bt crops represent a particular risk for producer moral hazard since refuge areas will be less productive and profitable than Bt crop areas.

The controversy associated with GMOs is particularly intense in the U.K. but is increasing in many areas of the world. In some instances, fields of GMOs have been attacked by protestors. For farmers this could ultimately mean problems with neighbors and outside groups. Farmers may not have protection against vandalized crops.

Distribution Risks

The risk of GMO contamination of non-GMO shipments increases as crops are accumulated at grain elevators and shipping terminals. Contaminating a load of non-GMO product may result in additional costs incurred to dilute the shipment to levels below those required, or worse it may result in the rejection of a load at a customer receiving facility. If that facility is a factory in Japan or the E.U. the resulting lawsuit will be large and spread across all those involved in the process or those with the ability to pay

This raises the issue of commitments and certification of GMO free shipments. Producers and grain distributors should be very careful that they can actually deliver on GMO level commitments. Exact quantitative DNA evaluation of GMO levels is complex, expensive and time consuming. Quick protein testing methods are reasonable indicators of presence above a certain threshold but do not provide exact quantitative assessment. The agricultural sector is working rapidly toward the development of identity preservation systems, testing methods and certification systems but at this point all require further development.

Market Risks

Consumer resistance to GMOs is closing some markets to genetically modified crops. Loss of markets may decrease the value of these crops. The problems associated with non-EU approved varieties of corn provide an excellent example. As the GMO controversy escalated through the summer of 1999, corn supply chains had to address the presence of non-approved varieties and the need to exclude them from all products destined for the EU. Companies and trade associations scrambled to identify locations to which non-approved varieties could be delivered. While this process was handled this year, the economic value of such varieties will almost certainly be reduced in the future. There will be other risks associated with market closure due to consumer demands or scientific revelations.

The practice of labeling foods containing GMOs may introduce further market related-risk. One risk is that consumers may perceive these labels as warning labels, and a further backlash against GMOs may occur. On the other hand, if there is a substantial price difference between labeled and unlabeled products, consumers may decide that the minimal risk is one worth taking. Labeling will definitely put more pressure on production and distribution to segregate and prove identity.

More disturbing to all members of the supply chain is the commitment by some retail chains, particularly in the U.K., to determine whether it is possible to remove GMOs from feed for animals destined as sources of meat for the chains. As mentioned earlier, Marks and Spencers has already done this for its free-ranging chicken, eggs, and pork. Testing the meat will not

reveal GMOs in the feed and the cost of using identity preservation systems and genetic identity testing for animal feed will add significantly to production costs. It is also possible that large grocery chains will actually vertically integrate with certain producers of meat to ensure compliance with GMO-free feed. Alternatively, buyers may refrain from purchasing produce from a broad section of producers in favour of expanded volume procurement from only a few producers or even a single producer. This may increase costs as minimum bids would likely rise, but this cost may well be offset by the lower costs of compliance monitoring and so on. As at the time of writing (October 1999), no large scale action has been taken, other than the Marks and Spencers initiative, but small organic production chains are setting up processes to achieve this.

Health Risks

Health risks are the most widely disputed area in the current GMO controversy. On the one hand, the scientific argument is that the input trait GMO crops are substantially equivalent to non-GMO crops. GMO opponents argue that the effects of prolonged use of GMOs is unproven. Different protein levels in GMO crops may have long term impacts on health. They turn the scientific arguments of the large biotechnology firms back on them – to patent a genetically modified organism the patent seeker must prove that the new organism is novel and inventive and not a simple extension of existing science. How can the same organism be novel and inventive on one hand and be the same as existing crops on the other? At this point no serious health related risks have been identified although a number of controversial studies are grabbing headlines. Researchers are currently expanding their studies in this area.

There are more immediate concerns related to health risks and the potential for lawsuits and insurance claims. As more genes are inserted into plants and animals it will become increasingly difficult to identify all components and contributors to food items. Genes from the Brazil Nut were inserted into soybeans for use in chocolate bars. The resulting chocolate had the potential for an allergic reaction among customers allergic to nuts. This risk was caught before the product reached the market, but it did raise awareness that such situations may arise in the future.

Risks Associated With Intellectual Property Protection

Biotechnology seed companies like Monsanto and AgrEvo are diligent in protecting the intellectual property associated with their technology and the long-term value of those technologies. These technologies are patented but they are also protected by contracts between the user and the seed company such as Monsanto's Technical User Agreement (TUA) that specifies the conditions for producing the seed. Producers not following the conditions in the TUA may be subject to liability in the case of environmental problems or legal action by Monsanto if they use the seed inappropriately.

GMOs AND LENDERS

At first glance, biotechnology and the controversy surrounding it might appear to be primarily a producer concern, beyond the scope of lender interest. However, there are several reasons why lenders should pay close attention to the debate and to the science of biotechnology. Biotechnology will change not only the crops produced but also the production system producing, processing and distributing them. The needs of producers and food processors for equipment and infrastructure will change. Where bigger was generally viewed as better in the past, small and identifiable will become more important in the future. The changes brought about by biotechnology will mean new opportunities for lenders but will also mean new categories and levels of risks

GMO Opportunities For Lenders

The largest opportunity for lenders is in the area of support for producer/processor identity preservation systems. Financing will be required for new smaller on-farm storage facilities, reorganized material handling and storage at elevator and processing facilities and dedicated harvest and handling equipment. Restructuring farm and elevator level operations to allow greater marketing flexibility will require significant new capital investments. Assessing the value of restructuring will require an understanding of the nature and value of identity preservation systems and the markets they serve. Lender support will also be needed for co-operative production ventures. Some may be funded through debt, others will require venture

capital or other equity funding arrangements. Lenders may take a role in organizing and financing these ventures.

GMOs Risks For Lenders

For lenders the most significant risks relate to produce viability in the face of changing markets, production patterns and prices brought on by biotechnology. Claims or lawsuits resulting from environmental or product contamination may also affect this viability. It is imperative that lenders ensure that producers take appropriate steps to mitigate risks related to biotechnology through processes, contracts, futures contracts and insurance.

In some cases bailment (or production) contracts are struck between producers and seed companies in which the seed company retains ownership of the crop and the producer receive a share of the value for producing the product. The potential exists for situations where crops pledged as security for loans are not actually owned by the farmer and thus not eligible as security.

For lenders and investors in start-up biotechnology firms significant risks exist around the willingness of investors to invest in a business which is experiencing so much uncertainty and controversy. Recently a British firm working to genetically alter fruit so that it would produce vaccines attempted a public offering in New York. Investors, frightened by the latest negative press over GMOs, avoided the issue. The offering failed and the company went into receivership.

Lenders face a less obvious but important market or image risk associated with being seen to take a stand one way or another on the issue of GMOs. If producers see lenders as discriminating against a product they view as beneficial and necessary, they may take their business elsewhere. If consumers view lenders as supporting the production of potentially harmful products, they may react adversely.

Lender Questions Related To GMOs

Lenders need information to make informed assessments of opportunities and risks and to make funding decisions. These questions should be directed at producers, elevators and processors, and at the lenders themselves. In the following section we suggest a series of questions that may assist lenders in better understanding and dealing with GMOs and their customers. The list is not complete in every respect but may help lenders begin the process of understanding GMOs and their impact.

Questions Lenders Should Ask Producers

Lenders have a responsibility to both their customers and shareholders to reduce the risk associated with GMO's. Part of this risk reduction involves being aware of the risks faced by clients with regards to GMOs and ensuring that customers are fully cognizant of their responsibilities and risks. There are a number of questions lenders should ask to assist them in understanding and assessing GMO related risks. These may be grouped into several categories as seen in Figure 2.

Questions Lenders Should Ask Elevators and Exporters

GMOs are the Y2K issue for elevators and exporters. The risk is there, but it is difficult to quantify and predict. Prevention is the best strategy for dealing with GMO problems. Questions which should be asked are found in Figure 3.

Questions Lenders Should Ask Themselves

Lenders have a responsibility to both clients and shareholders to protect their organizations from unexpected losses related to GMOs. They must be cognizant of their own risk exposure, their strategies for reducing that exposure and the impact those strategies might have on customers of all types. Some questions which lenders should ask themselves are found in Figure 4.

GMOs AND THE FUTURE

There is little doubt that biotechnology is here to stay. Much of the pharmaceutical industry is built on recombinant technology. While some consumers are unaware of this fact, those who are generally accept that the risks are outweighed by the benefits. In agriculture, biotechnology will

thrive when consumers see benefits that outweigh their perceived risks. Crops with input traits will not do this; only crops with quality traits are likely to provide sufficient benefit to create dramatic swings in consumer attitude. It may be years before the issues settle and the true value of GMOs is known. In the meantime, there will turbulence for all members of agrifood supply chains until technology and processes are in place to segregate crops accurately and consistently. Ultimately there will be many different crops and different supply chains for those crops. The ability to segregate will provide a marketing advantage in the short term and will be a requirement for market entry in the long term. For lenders it is critical to monitor the situation closely and to develop strategies for reducing both producer and lender risks associated with biotechnology.

References

Halwell B., "The Emperor's New Crops", *World Watch*, July/August 1999, 21-29.

Impacts of Adopting Genetically Engineered Crops in the U.S. -- Preliminary Results, July 20, 1999 Presented at the Transitions in Agrobiotechnology Conference, Washington, D.C., June 24-25, 1999.

Lipton, K, "Impact of Adoption of Herbicide-Tolerant and Insect-Resistant Crops", USDA research report, http://www.econ.ag.gov/whatsnew/issues/gmo/modeling.htm, July 1999.

Figure 2. Questions Lenders Should Ask Producers

1. *Awareness of producer production plans*
   - Are you producing any GMO Crops?
   - Are those crops sold to outside markets?
     - Which markets? Who are the ultimate consumers?
     - Do those markets accept GMO crops?
     - Are the GMO crops E.U. approved varieties or non-E.U. approved?
   - Do you use GMO crops as animal feed? For which market are the animals destined?
   - Have you or will you be signing a Technical User Agreements (TUA)?
     - Do you understand all the clauses in the TUA?
     - Are you (or will you be) in compliance with all provisions of the agreement?
   - Are you producing and marketing non-GMO Crops for non-GMO markets?
     - What kinds?
     - Are you certifying the crops as non-GMO? How?
     - What are the thresholds in the certification?
   - If you are producing both GMO and non-GMO crops is there adequate separation between the two?
   - How will you ensure that your GMO crops will not affect or contaminate crops owned by neighbors?
   - Have you discussed your production plans with your customers?

2. *Understanding producer marketing arrangements*
   - Are you producing products under contract?
   - Is the contract a Bailment (Production) contract and how secure is that contract?
     - Can payment be assigned to the lender?
   - If you are producing a special crop, either high value GMO or non-GMO, how will you market the product and preserve is identity to capture the value?
   - What are you promising to deliver to your customer?
   - Will you check your crop and how?

3. *Spreading the risk*
   - Will your insurance cover contamination of non-GMO shipments or environmental contamination?
   - Does the insurance contract contain any clauses related to GMOs?

4. *Exploring opportunities for producers and lenders*
   - Do you have on farm storage?
   - Can that storage be used as part of an identity preserved production system?
   - Are there marketing opportunities that require financial support for identity preserved infrastructure like new bins or material handling equipment?
   - Are there opportunities which could be exploited if a cooperative arrangement was made between a grain handling organization and producers in a particular region?

Figure 3. Questions Lenders Should Ask Elevators and Exporters

- Who are your customers and who is the ultimate consumer?
- What are customer plans for GMOs?
- How must you change operations to remain in current markets and meet their requirements?
- Are you prepared to deal with identity preserved production?
- How will you prove to your customers that the product is what you say it is?
- What will you require from suppliers?
- What are the implications of failure?
- Are there new opportunities which altered capabilities could make available?

Figure 4. Questions Lenders Should Ask Themselves

- What kinds of covenants should be added to reduce GMO risk?
  - Should new GMO covenants be added to loan agreements? Some banking arrangements require statements of environmental responsibility are statements of GMO responsibility required?
- Does the process of due diligence need to change for security on working lines, income and loan balances.
- Do current insurance coverages protect farmers from GMO related liability damages?
- Do banking policies promote or discriminate against GMOs and how will producers and other customers perceive these policies?
- How will the bank monitor collateral and collateral value in the face of market shifts?